WHAT IS CLAIMED IS:

1. A manufacturing method of a photo mask blank having a thin film for forming a pattern on a transparent substrate, comprising steps of:

directing the surface of a target downwards and the surface of a substrate upwards with respect to a gravity direction; shielding a peripheral edge of said substrate to prevent the film from being formed on the peripheral edge; and sputtering/forming said thin film.

2. A manufacturing method of a photo mask blank having a thin film for forming a pattern on a transparent substrate, comprising a step of:

manufacturing said thin film using a DC magnetron sputtering apparatus comprising at least a sputtering target, a magnetron cathode with the target attached thereto, a substrate holder disposed opposite to said target, and a shield disposed on an inner wall of a vacuum tank inside the vacuum tank,

wherein the surface of a target is directed downwards with respect to a gravity direction, and

the apparatus has a mechanism for reducing film formation on a non-sputtered area on the target and the surface of the shield.

3. The manufacturing method according to claim 2

wherein said mechanism for reducing the film formation onto the non-sputtered area on the target comprises a mechanism in which a whole-surface erosion cathode is used as the magnetron cathode, a mechanism for shielding the non-sputtered area on the target, or a mechanism for roughening the surface of a non-sputtered portion on the target.

4. The manufacturing method according to claim 3 wherein said mechanism for reducing the film formation onto the non-sputtered area on the target further comprises a mechanism for forming a corner in the target into a curved surface, and roughening an end surface of the target.

5. The manufacturing method according to claim 2 wherein the mechanism for reducing the film formation on the shield surface keeps the shield at a constant temperature, and a shape of the shield is designed so that a relative film formation speed t in the following equation (i) in at least a shield position in the vicinity of the target is prevented from being larger than a value in a position on the substrate:

$$t = \cos\theta_1 \times \mathrm{Sin}(\theta_1 - \theta_2)/r^2 \quad \text{(i)}$$

(in the equation (i), r denotes a distance between a target center and a shield position, θ_1 denotes an angle of a line connecting the target center to the shield position with respect to a normal of a target plane, θ_2 denotes an angle of a shield plane with respect to the normal of the target plane,

and t denotes the relative film formation speed in the shield position defined by r and θ_1).

6. The manufacturing method according to claim 5 wherein the mechanism for reducing the film formation onto said shield surface comprises a mechanism for forming a corner in the shield into a curved surface, roughening the surface of the shield, and disposing an earth shield above the target plane.

7. The manufacturing method according to claim 2 wherein the apparatus further comprises a backing plate to which the target is to be attached, and the surface of the backing plate is roughened.

8. The manufacturing method according to claim 2 wherein the apparatus further comprises a shield plate for preventing the film from being formed on a peripheral portion of the substrate.

9. A photo mask blank manufactured using the manufacturing method according to claim 1.

10. A photo mask blank manufactured using the manufacturing method according to claim 2.

11. A photo mask blank having a thin film for

forming a pattern on a transparent substrate,

wherein a total number of particles and pinholes having a diameter larger than a diameter equivalent in size to an exposure wavelength for use in said blank as a mask is 0.1 or less per square centimeter.

12. A photo mask blank having a thin film for forming a pattern on a transparent substrate,

wherein an exposure wavelength for use in said blank as a mask has a center wavelength of 193 nm or less, and a total number of particles and pinholes having a diameter larger than 0.2 μm is 0.1 or less per square centimeter.

13. The photo mask blank according to claim 11 wherein said thin film for forming the pattern is a light semi-transmission film, and said photo mask blank is a halftone phase shift mask blank.

14. The photo mask blank according to claim 12 wherein said thin film for forming the pattern is a light semi-transmission film, and said photo mask blank is a halftone phase shift mask blank.

15. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 1.

16. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 2.

17. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 3.

18. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 4.

19. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 5.

20. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 6.

21. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 7.

22. A manufacturing apparatus of a photo mask blank for carrying out the manufacturing method according to claim 8.

23. A photo mask manufactured by patterning a thin film in the photo mask blank according to claim 9.

24. A photo mask manufactured by patterning a thin film in the photo mask blank according to claim 10.

25. A photo mask manufactured by patterning a thin film in the photo mask blank according to claim 13.

26. A photo mask manufactured by patterning a thin film in the photo mask blank according to claim 14.

27. A pattern transfer method using the photo mask according to claim 23 to transfer a pattern.